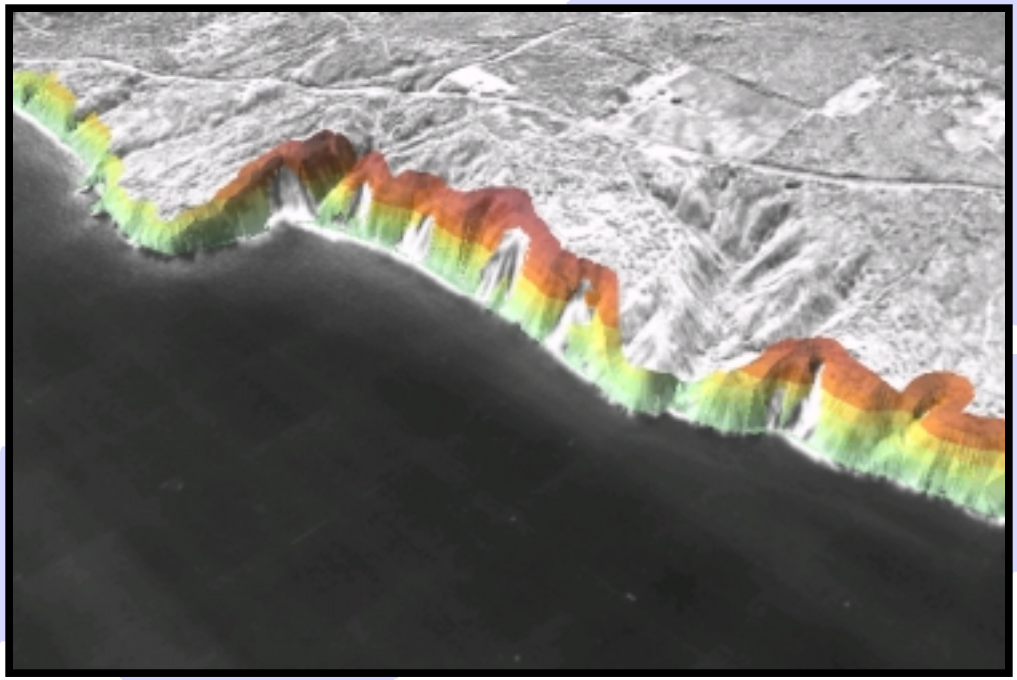
COASTAL EROSION

Lake Superior Shoreline Recession Analysis using Historic Aerial Photography



Mark Miller
Benchmark GIS

Funded by
Wisconsin Coastal Management Program

Presentation Goals

- Overview of study
- Recession analysis and visualizations
- Web-based resources

Coastal Land Ownership in Bayfield County

- 114 miles of Lake Superior shoreline
- More than 1200 parcels situated along the lake (1% of land area)
- Small parcel sizes (6.2 acres) along shore
- Account for 5% of total number of private parcels
- Account for 10% of total private land value in county
- Some extend less than 150’ from existing shoreline

COASTAL EROSION

Related Studies

Whittlesey Creek Watershed

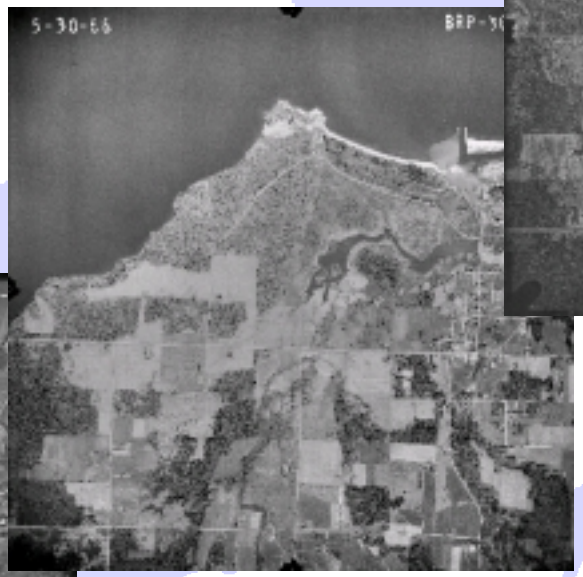
- Analysis of current and historic aerial photography

- Use of sophisticated mapping tools to compare multi-year terrain models

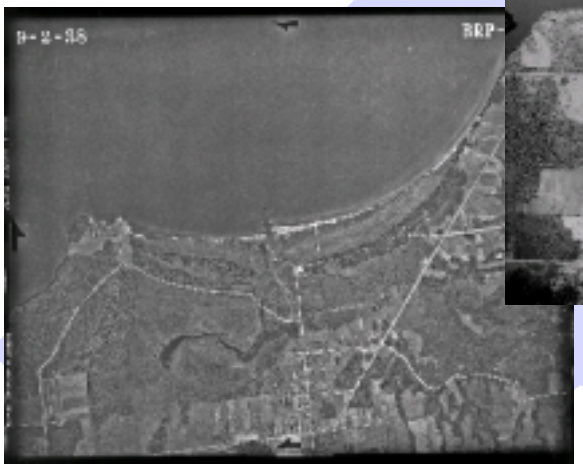
COASTAL EROSION

Historic Aerial Imagery

1990

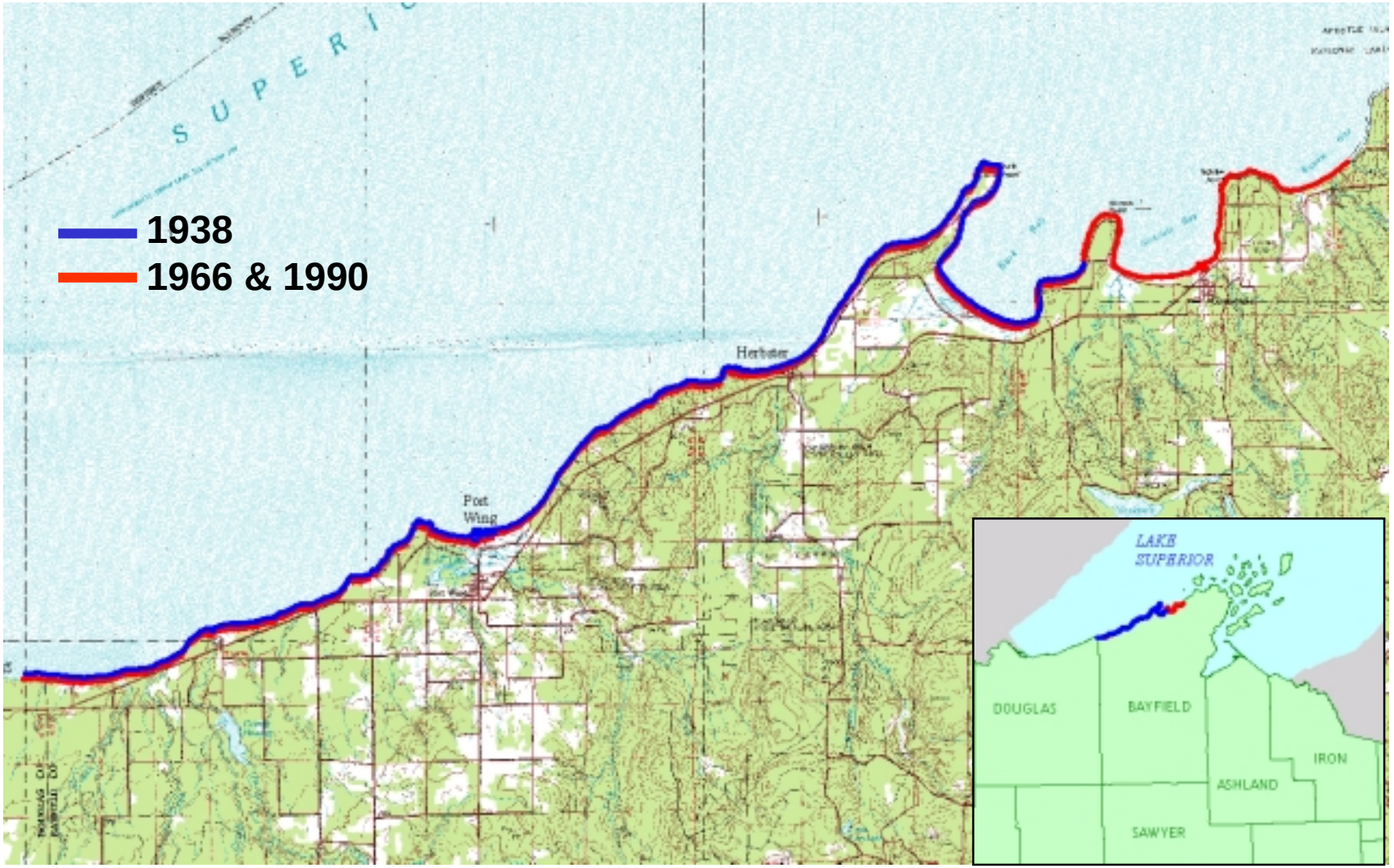


1966



1938

Study Area

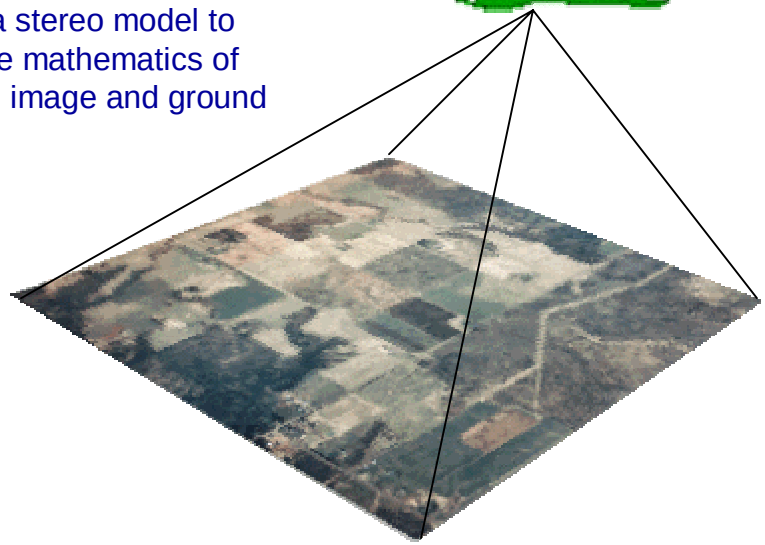

1938
1966 & 1990
Herbster
Port Wing
LAKE SUPERIOR
DOUGLAS
BAYFIELD
IRON
ASHLAND
SAWYER

Photogrammetric Principals

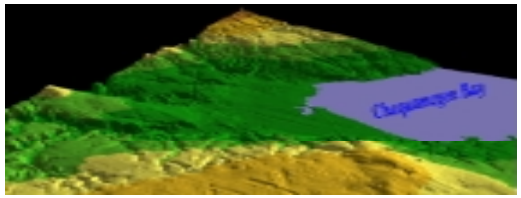
Picking photo fiducials and entering camera calibration provides *interior orientation*

Correlating photo features with actual ground coordinates captured using GPS provides *exterior orientation*

Photogrammetry software builds a stereo model to recreate mathematics of sensor, image and ground

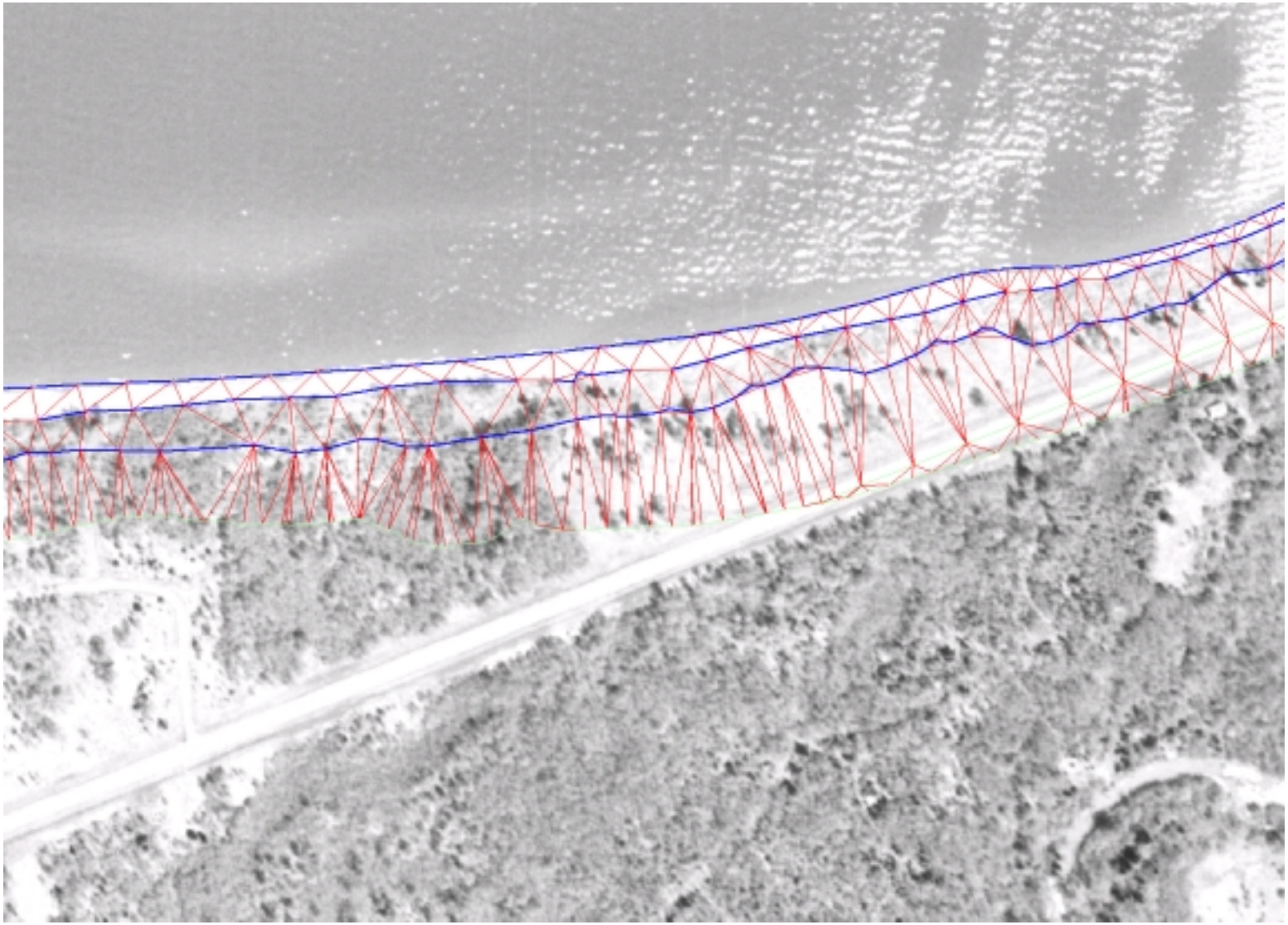


Terrain models are used to model and remove elevation distortion



Stereo model and terrain model combine with original imagery to create orthophoto.

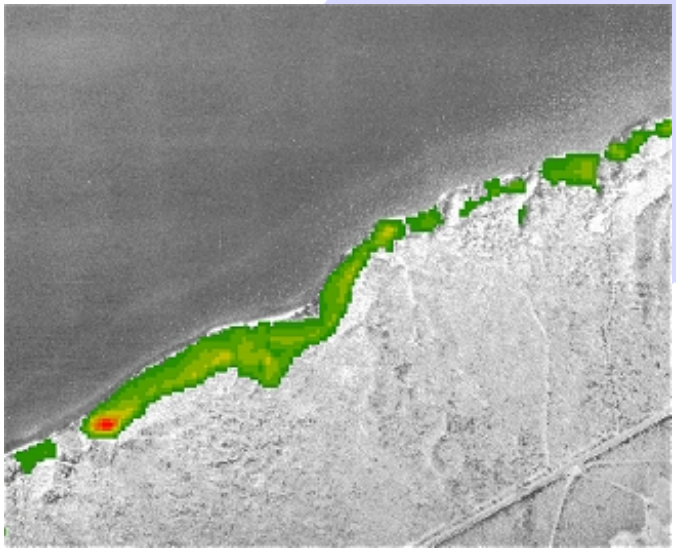
3D Shoreline Delineation

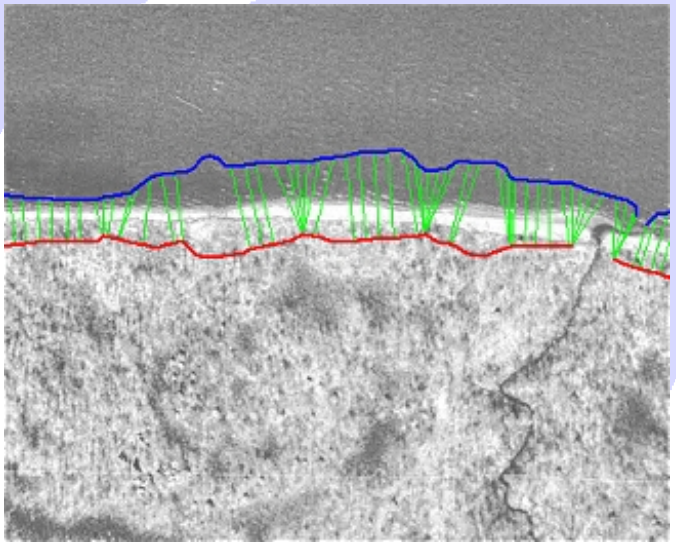


Analysis

Two analyses performed to evaluate the potential of derived products:

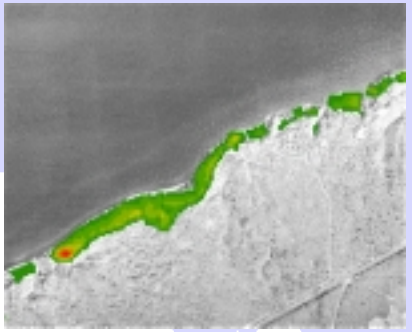
- **Volumetric analysis**
- **Ridge recession analysis**





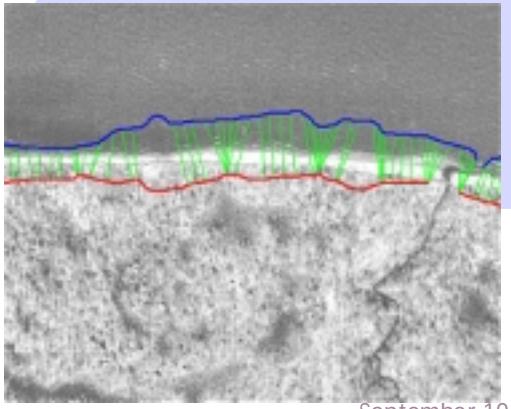
Volumetric Analysis

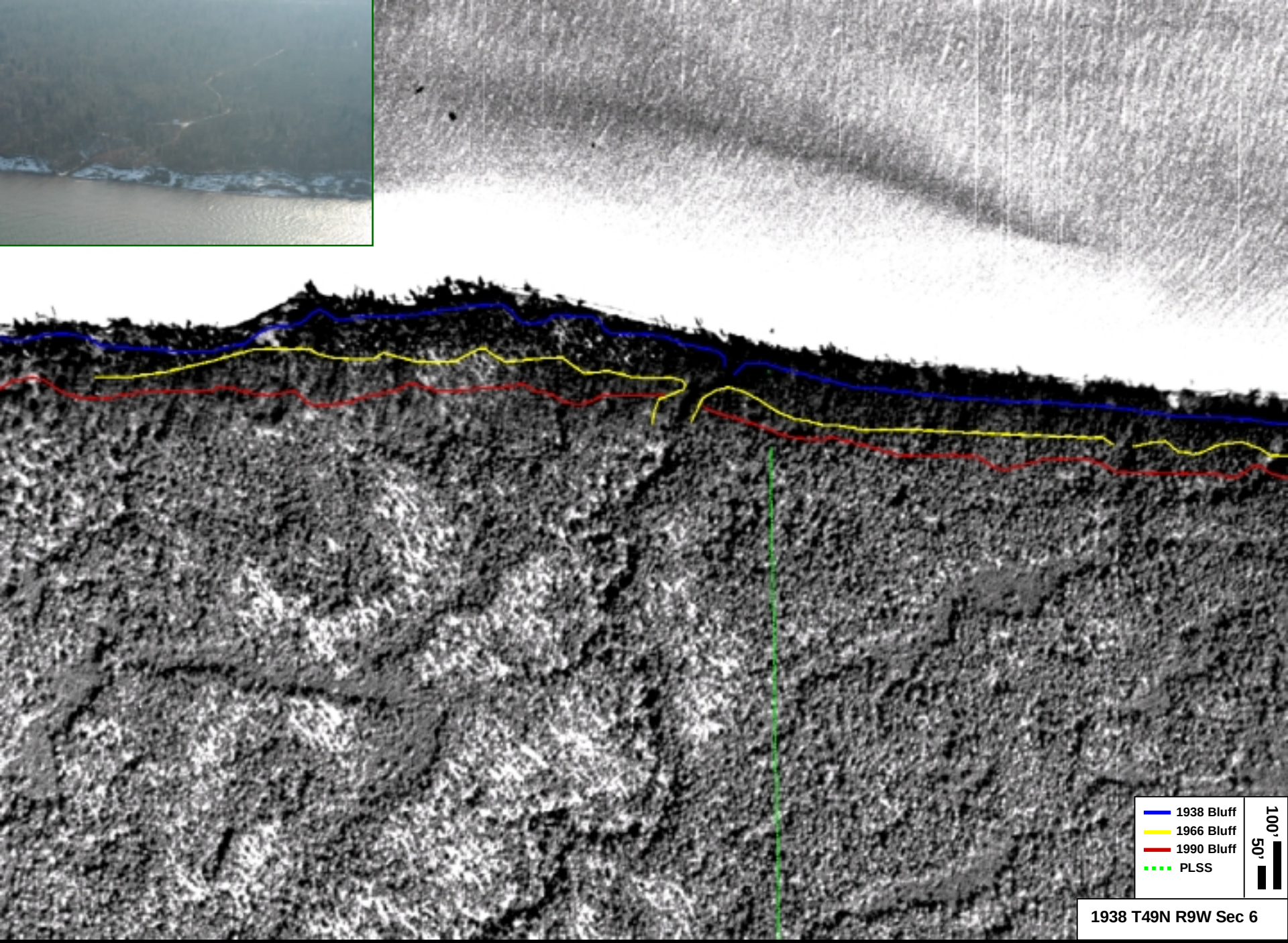
- Subtract terrain models from each other
- Each 10-meter cell (pixel) represents 100 square meters; a 1-meter difference in height = 100 cubic meters
- For 28 mile stretch (1938-1990) :
  - 4 million cubic meters lost
  - 77,000 cubic meters per year
  - 2,800 cubic meters per mile per year

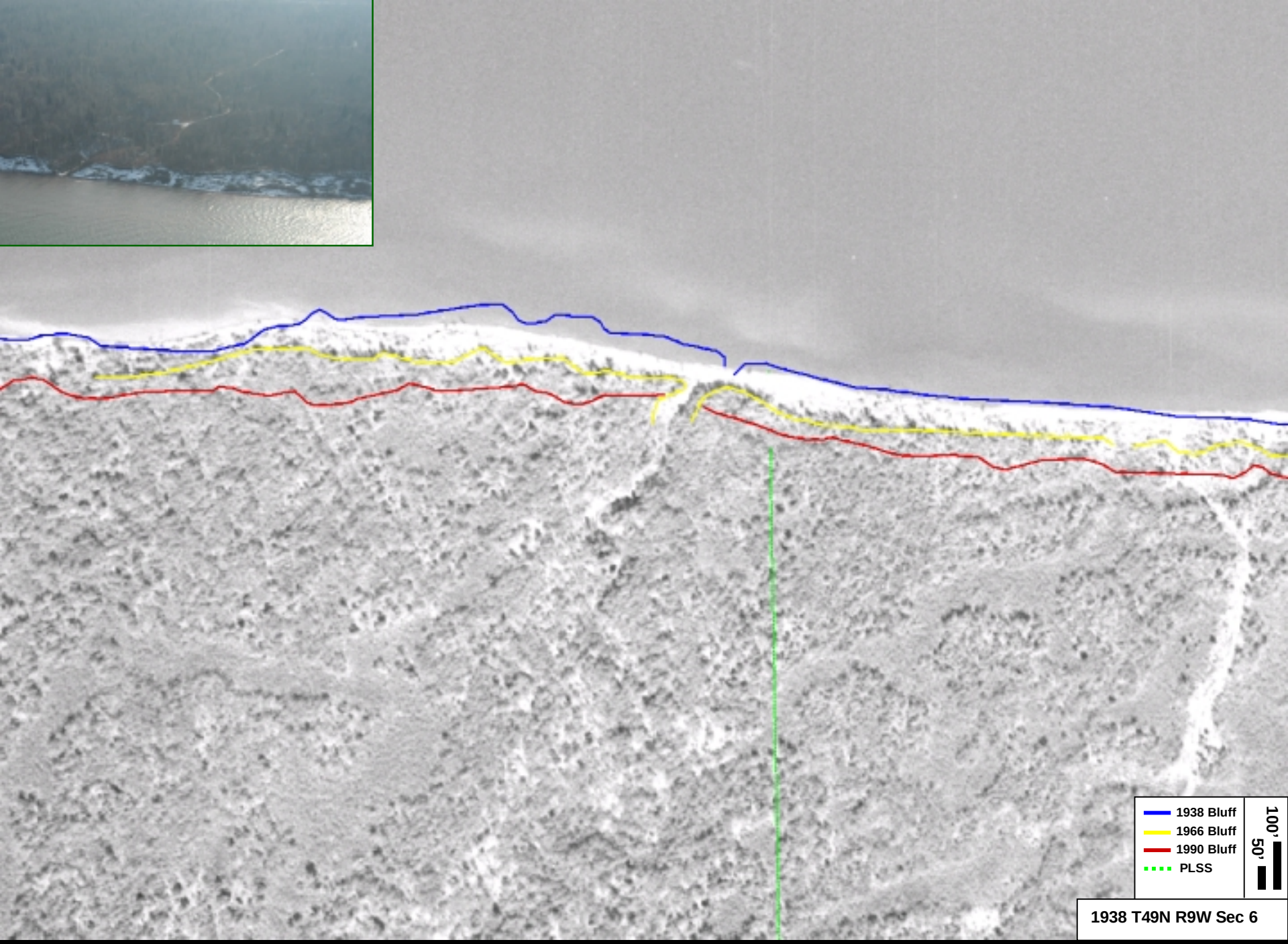


Ridge Recession Analysis

- Software written to calculate distance between bluff lines
- Provides measure of change along entire shore
- Most extreme measure between 1938 and 1990: 57 meters, or 1.1 meters per year




1938 Bluff
1966 Bluff
1990 Bluff
PLSS
100'
50'
1938 T49N R9W Sec 6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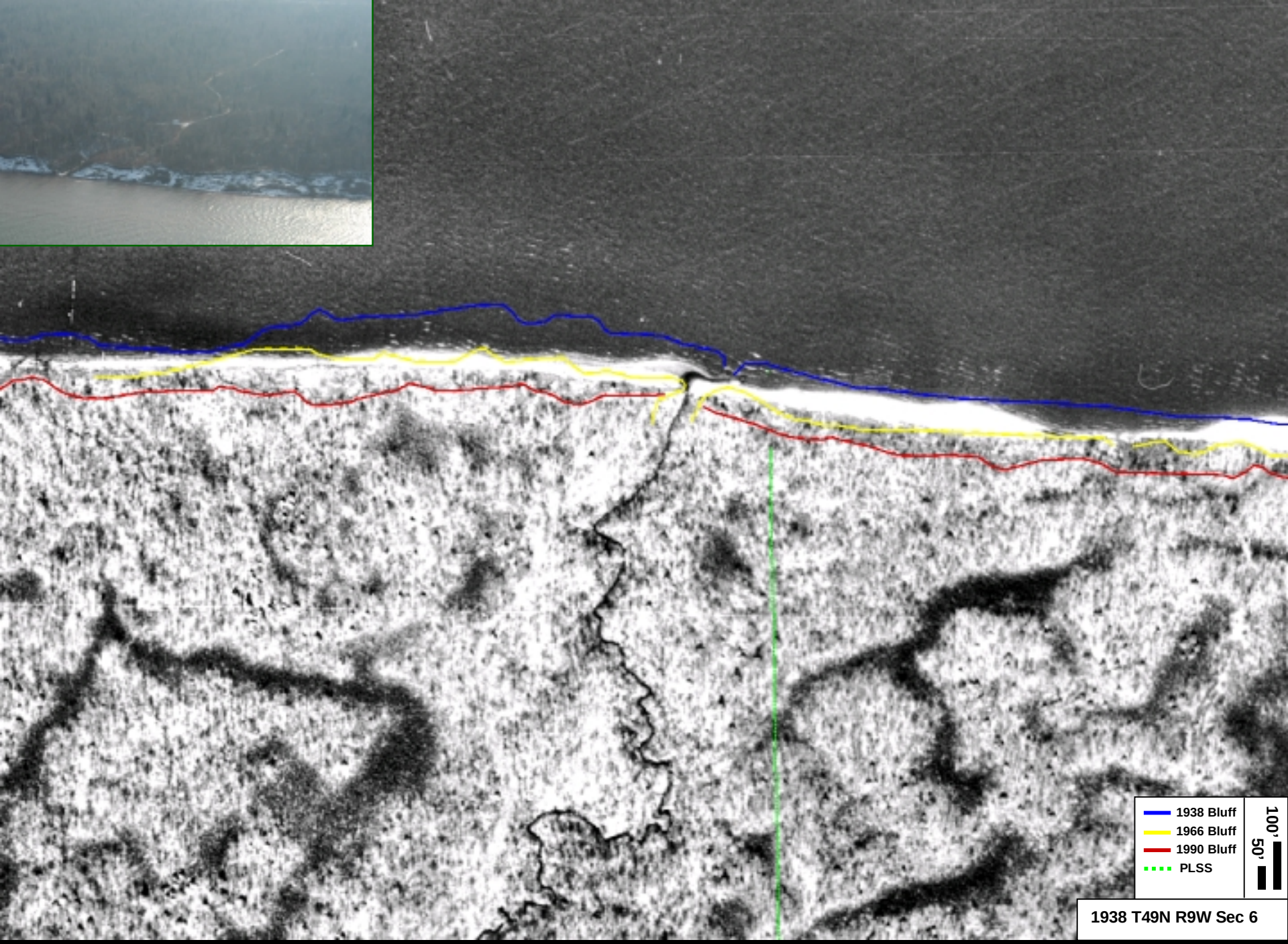
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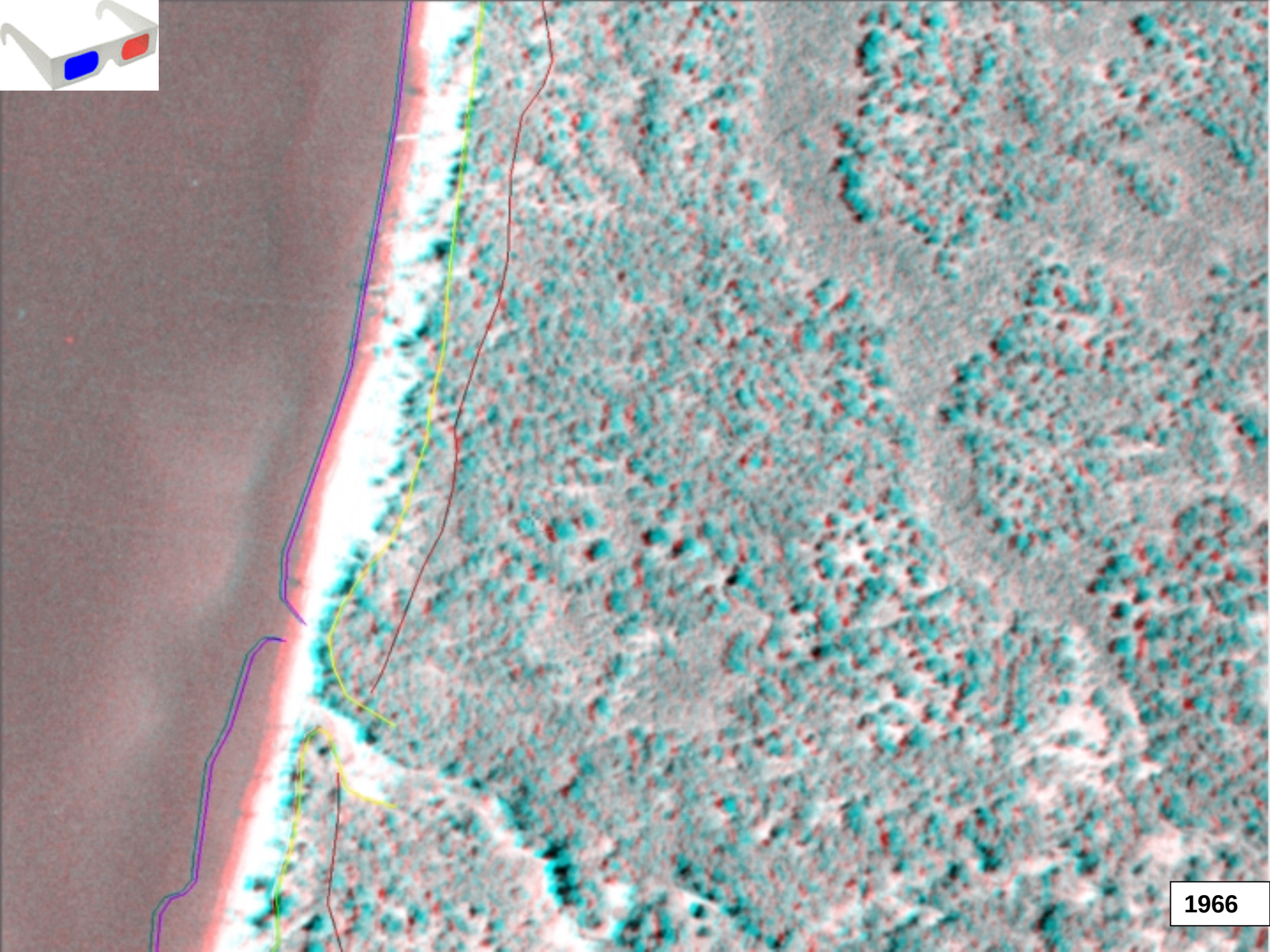
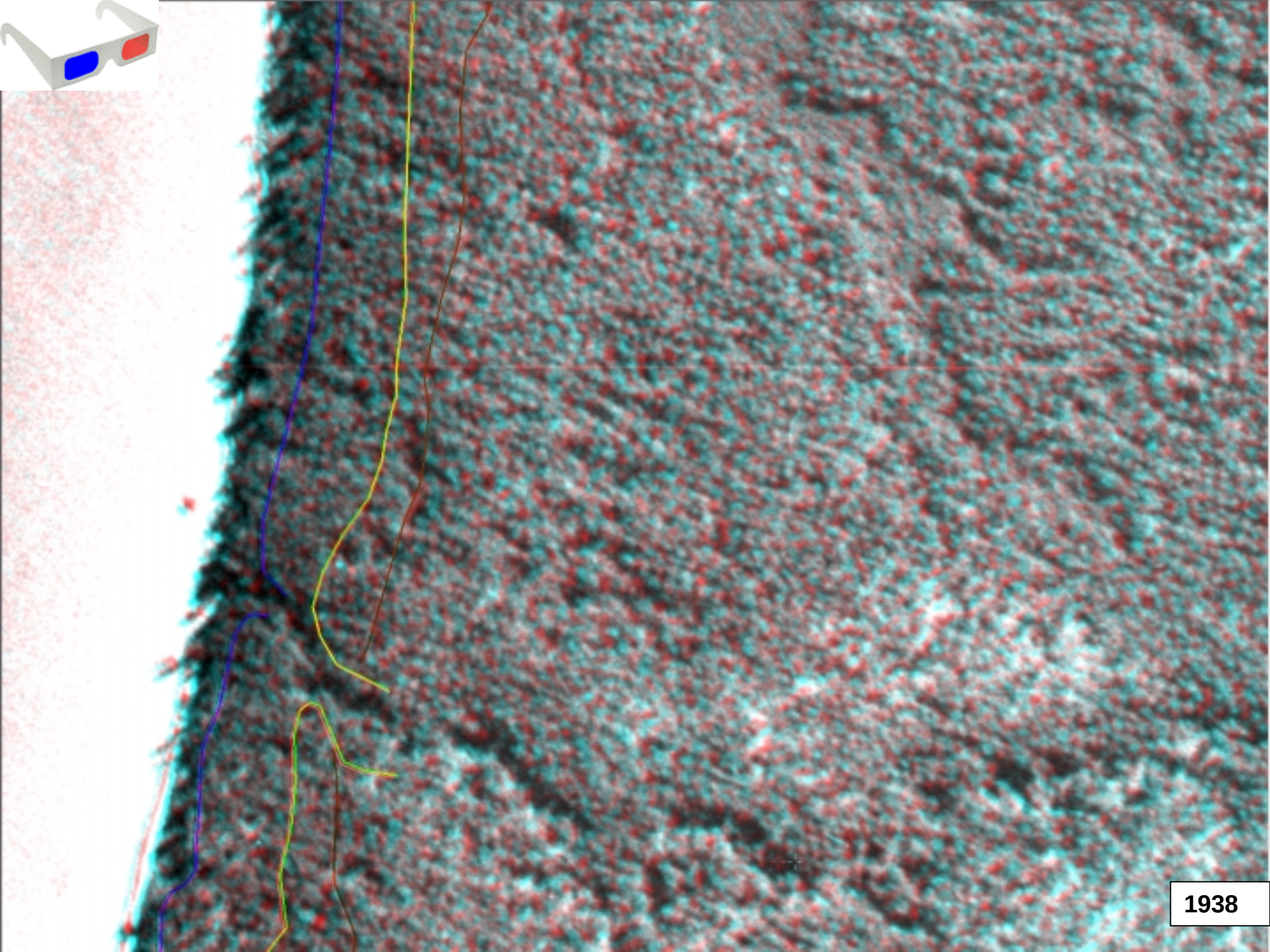
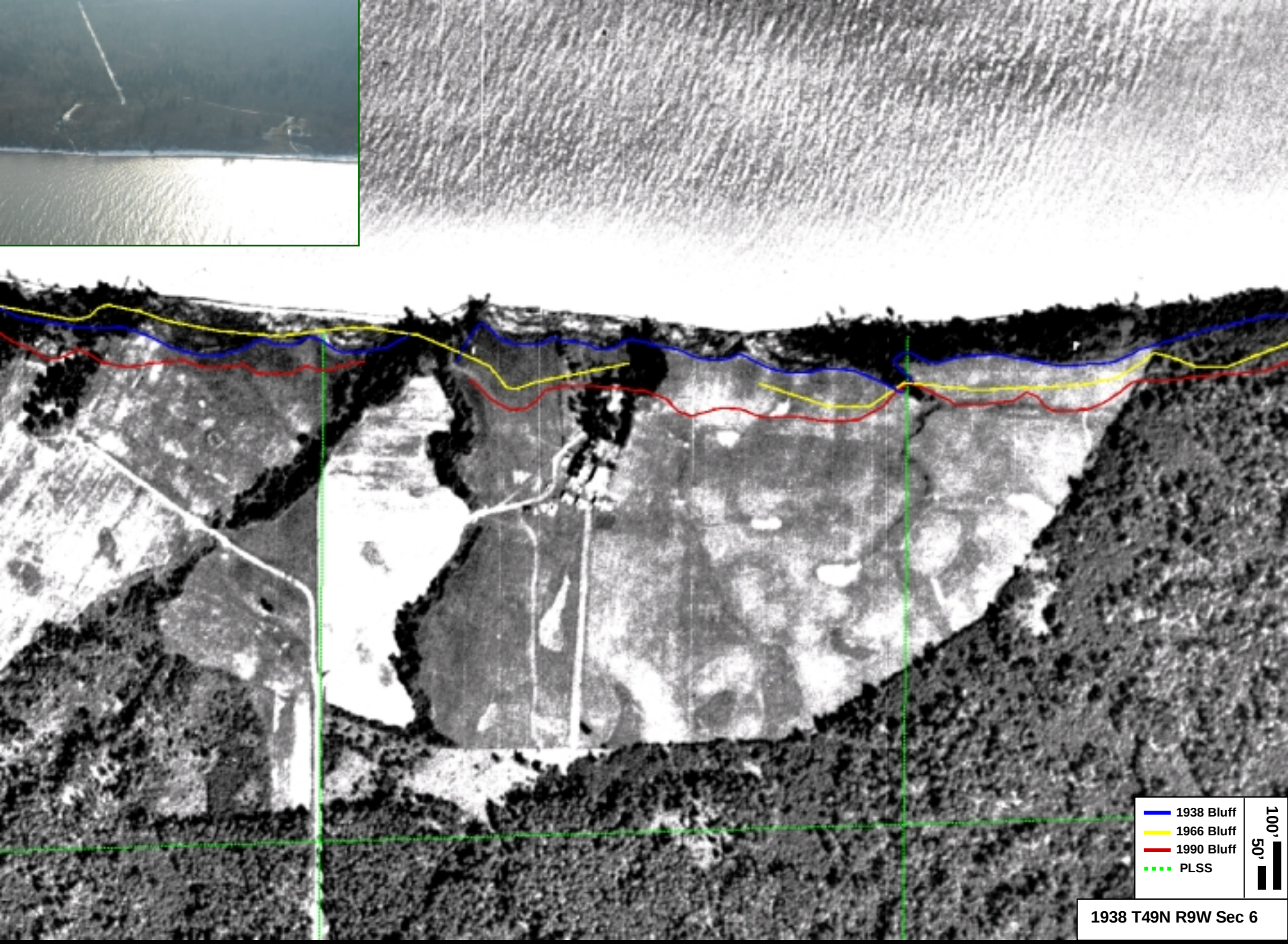

1966


1938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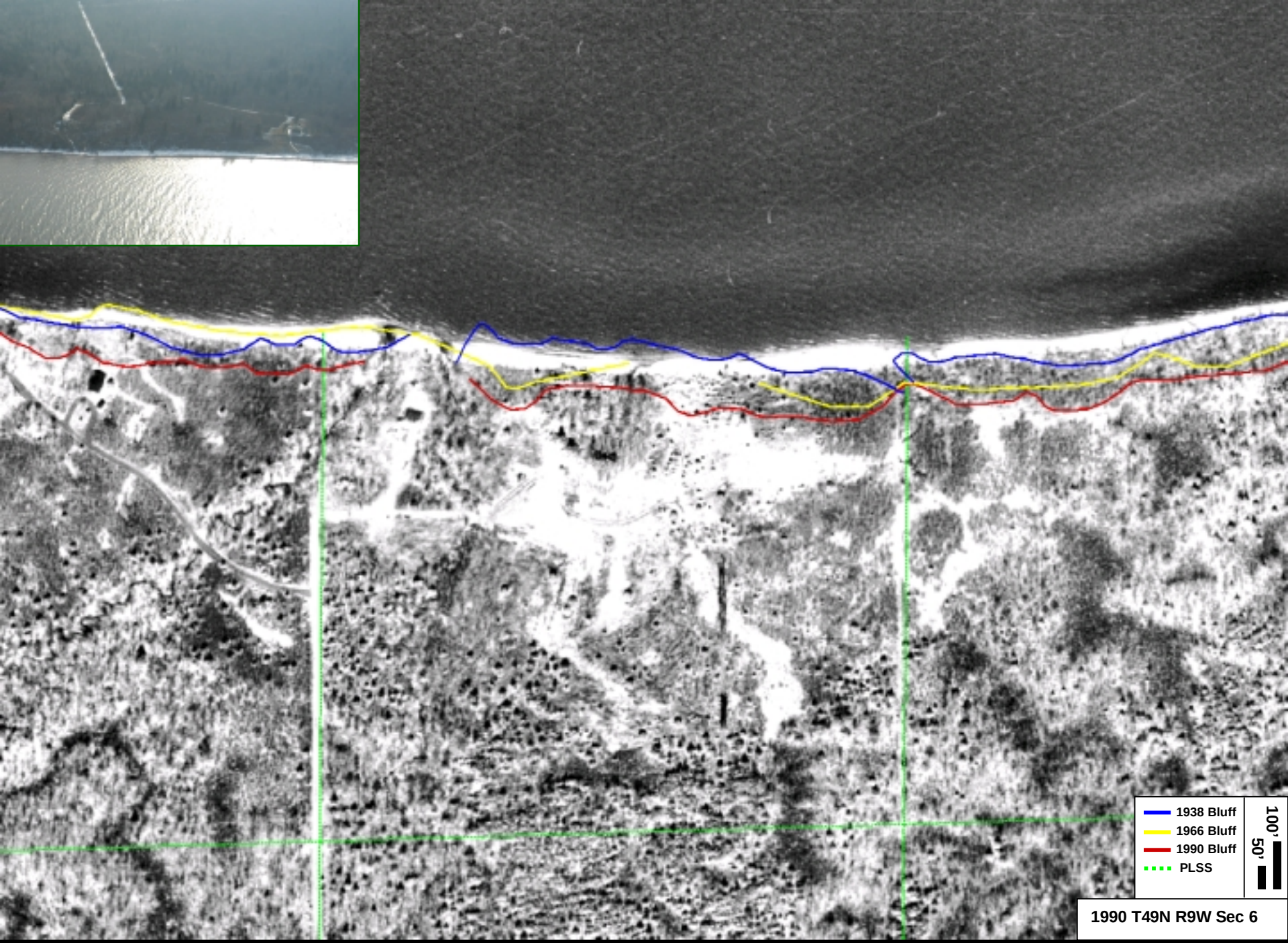
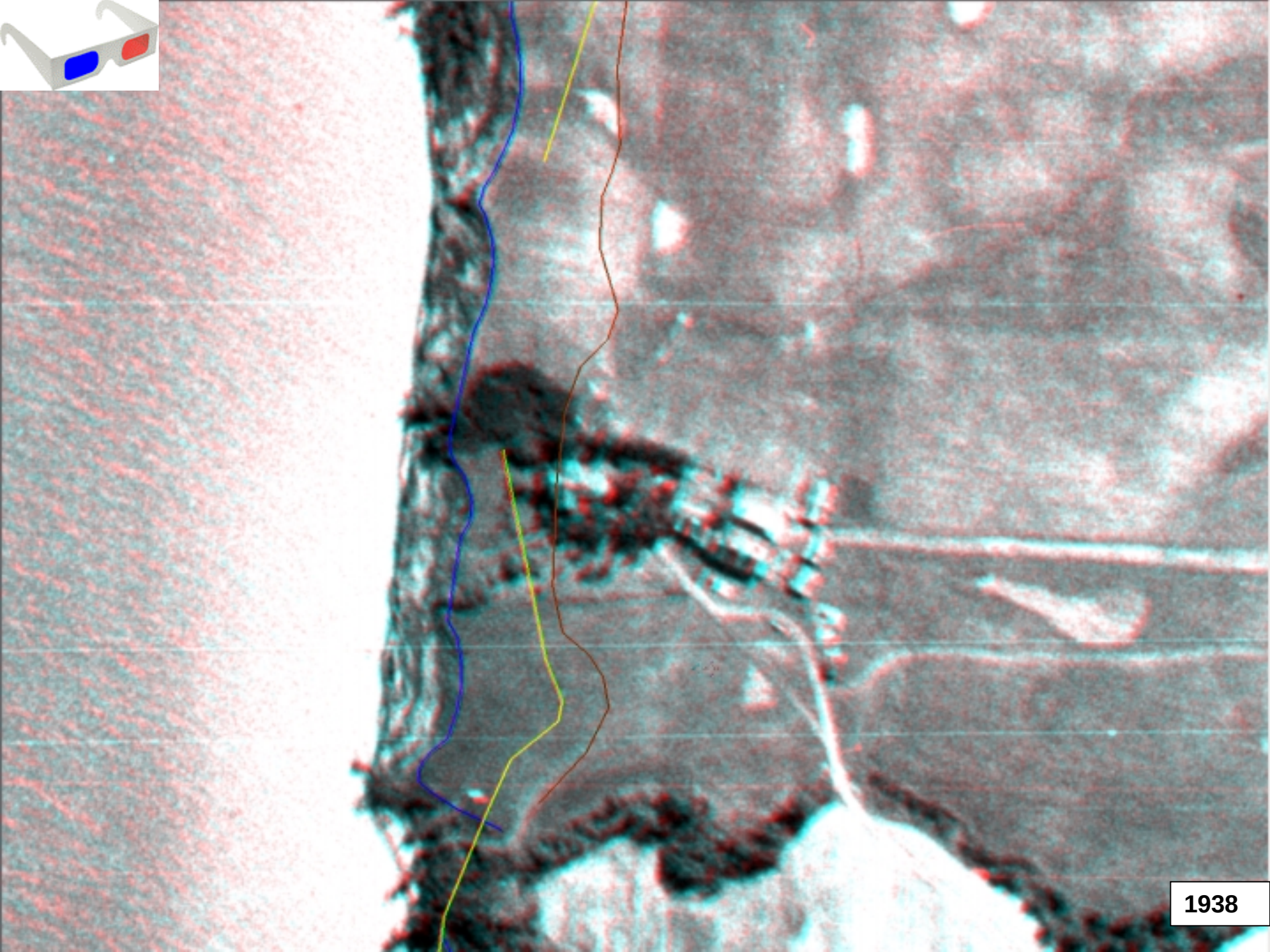
1966 Bluff
1990 Bluff
PLSS
100'
50'
1938 T49N R9W Sec 6

1938 Bluff
1966 Bluff
1990 Bluff
PLSS

100'
50'

1966 T49N R9W Sec 6


1938 Bluff
1966 Bluff
1990 Bluff
PLSS
100'
50'
1990 T49N R9W Sec 6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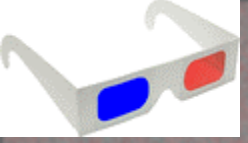
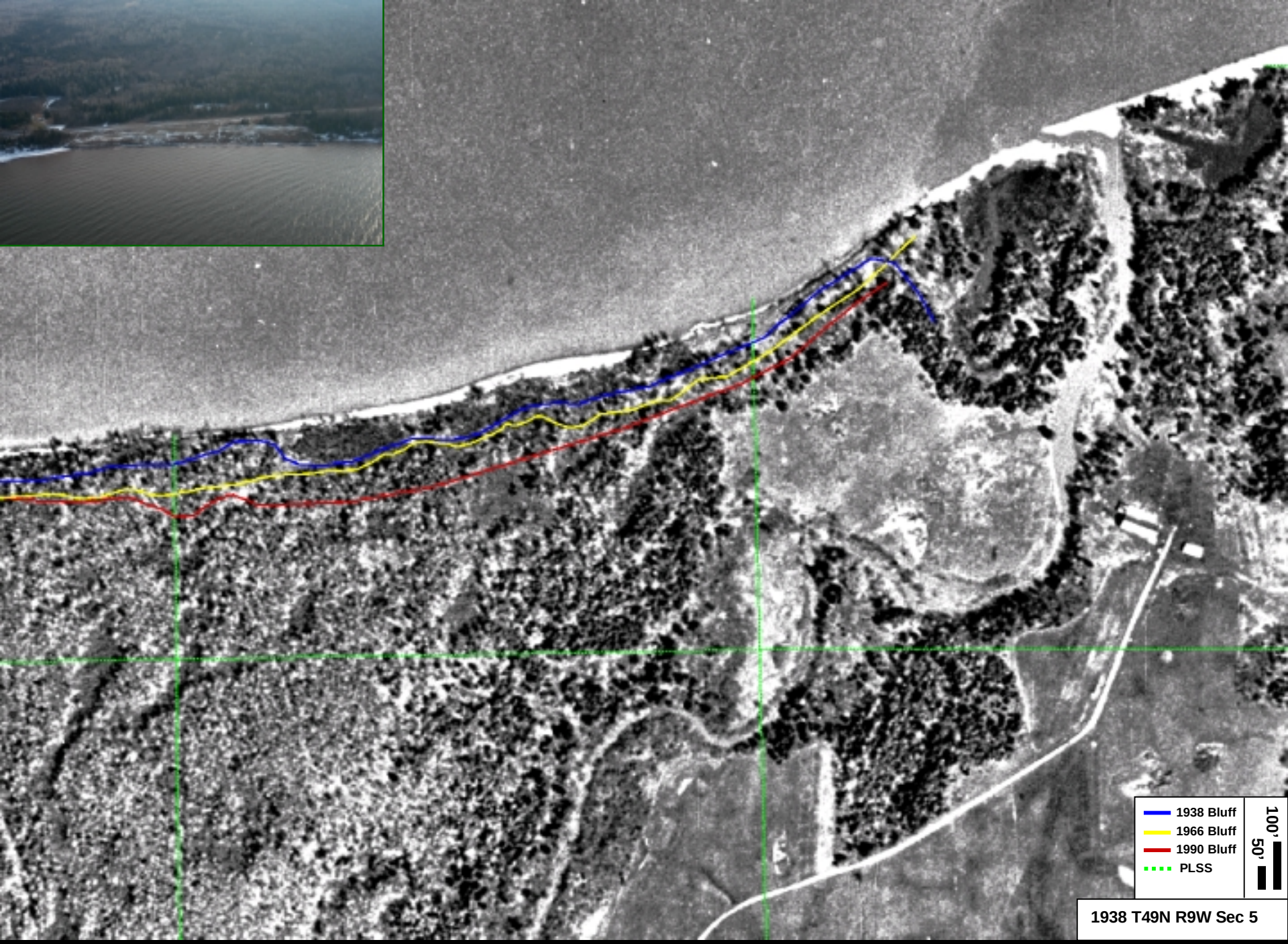
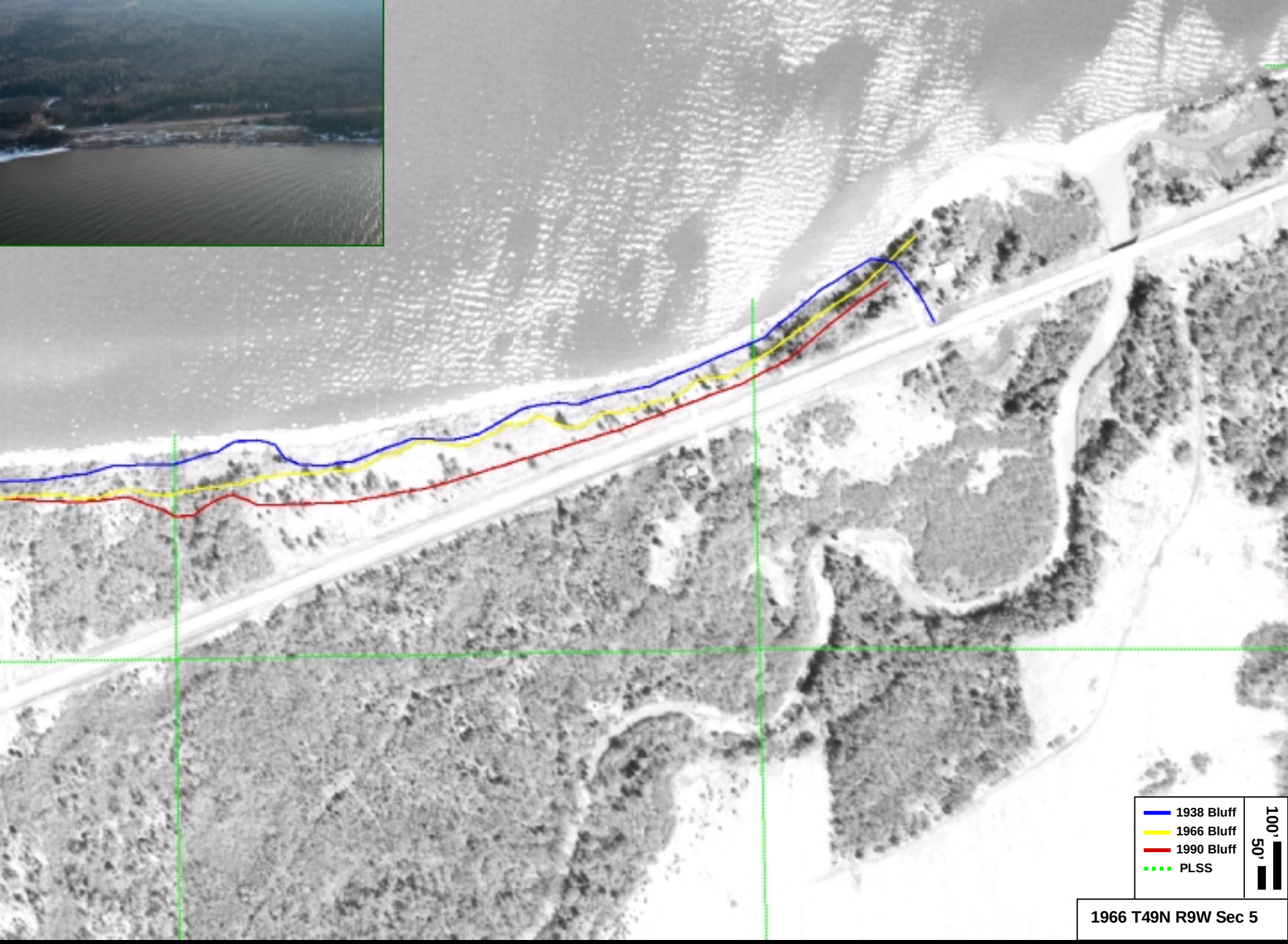
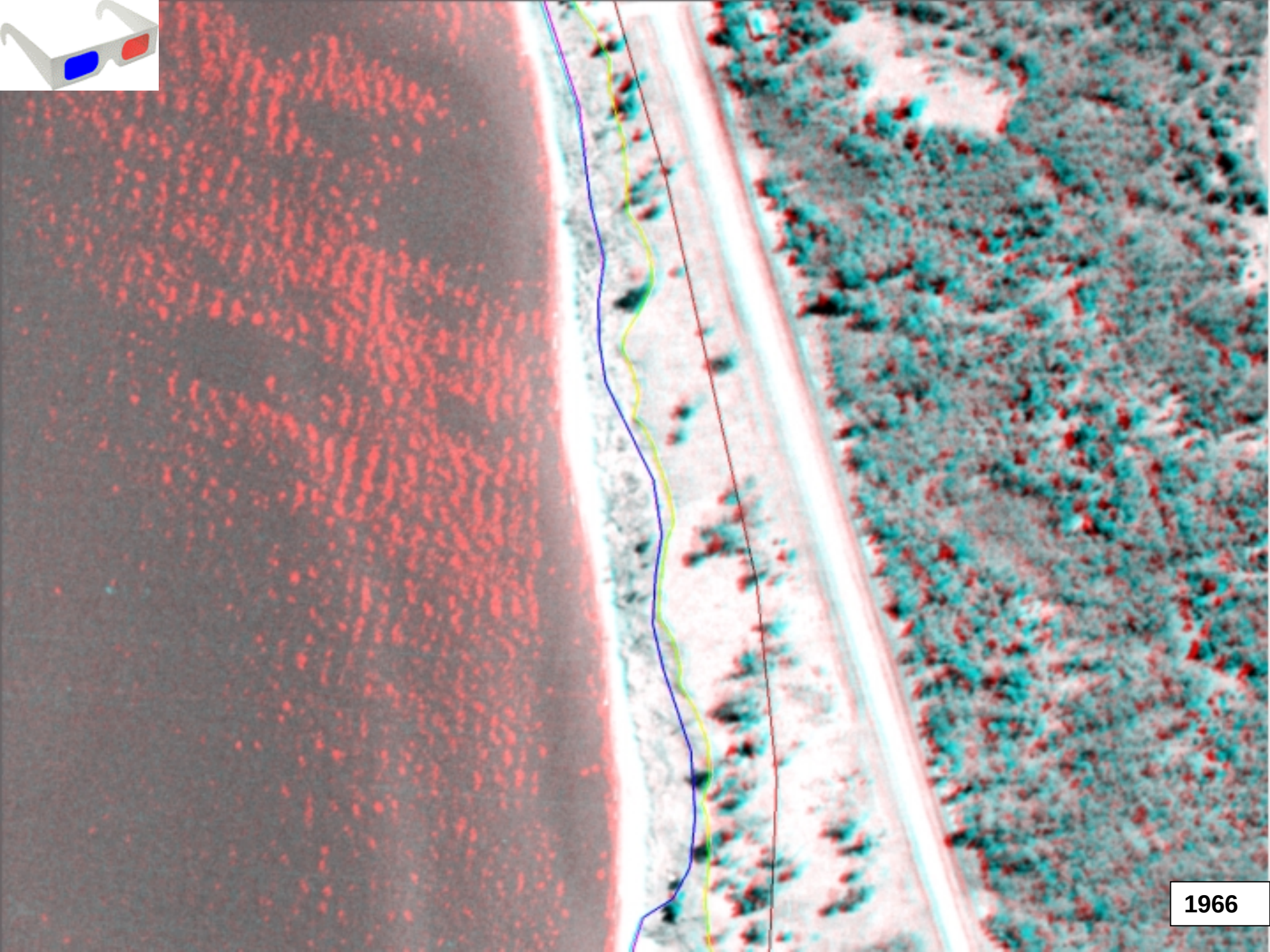


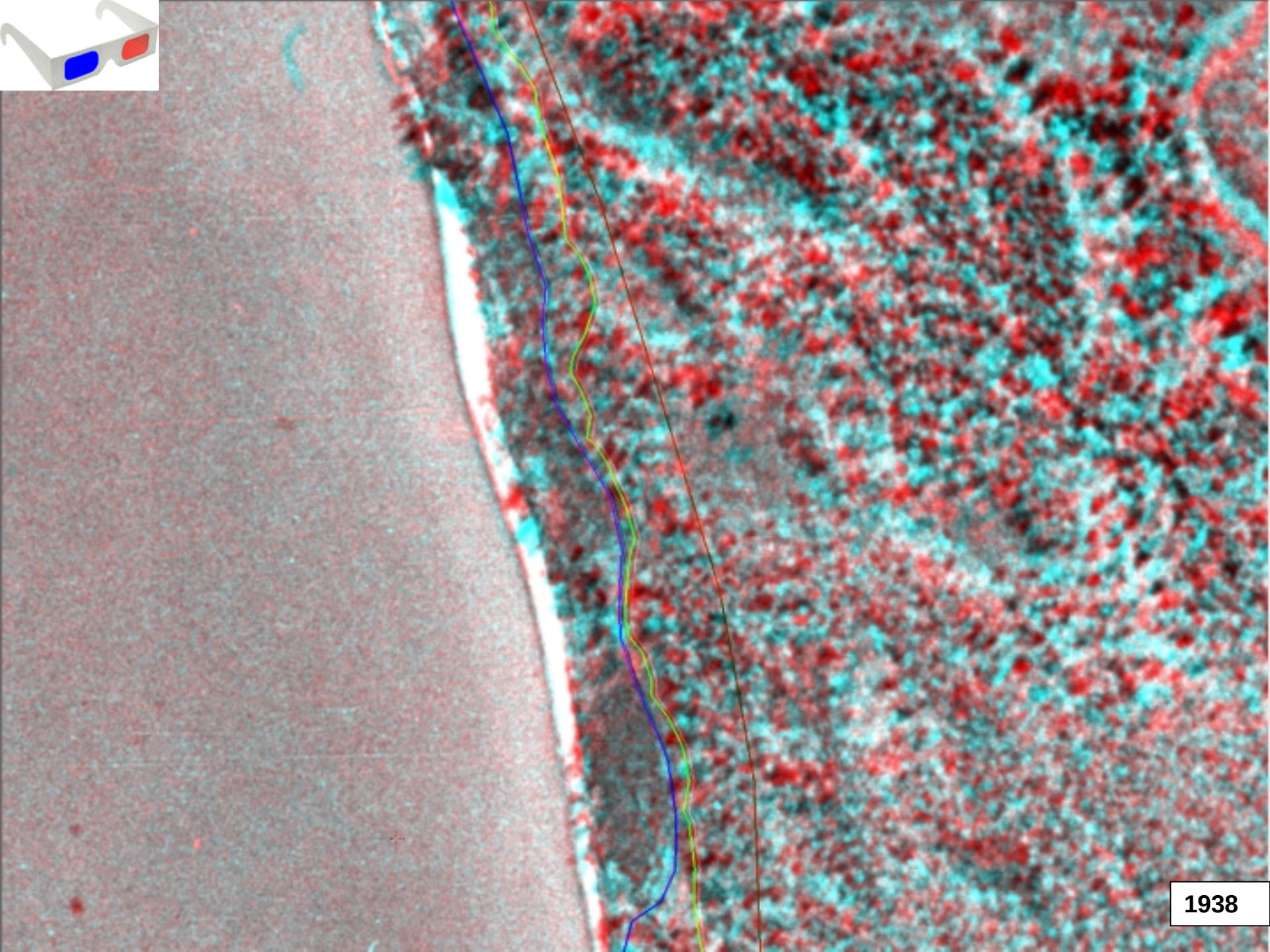
1966


1938 Bluff
1966 Bluff
1990 Bluff
PLSS
100'
50'
1938 T49N R9W Sec 5


1938 Bluff
1966 Bluff
1990 Bluff
PLSS
100'
50'
1966 T49N R9W Sec 5


1938 Bluff
1966 Bluff
1990 Bluff
PLSS
100'
50'
1990 T49N R9W Sec 5


1966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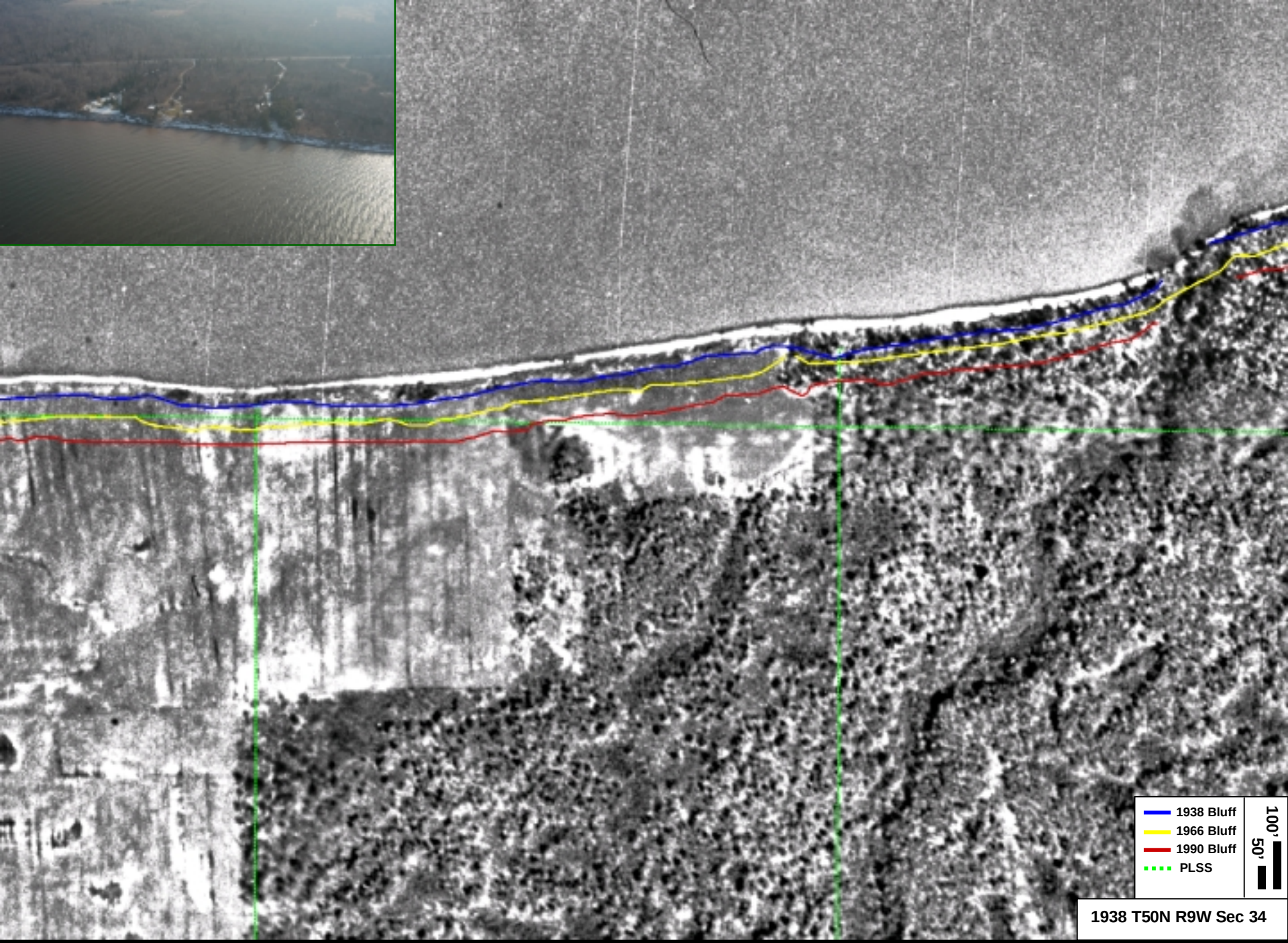
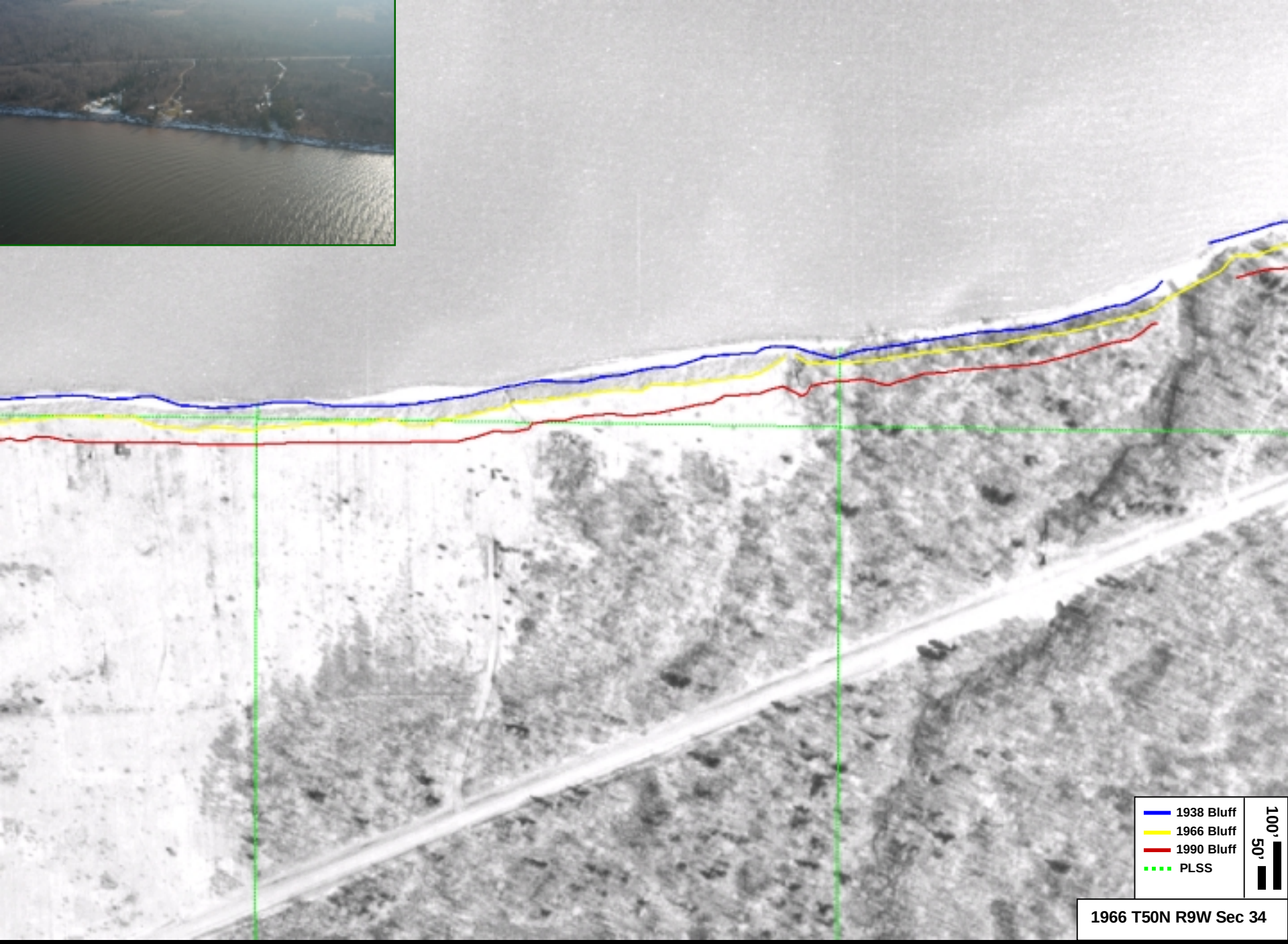
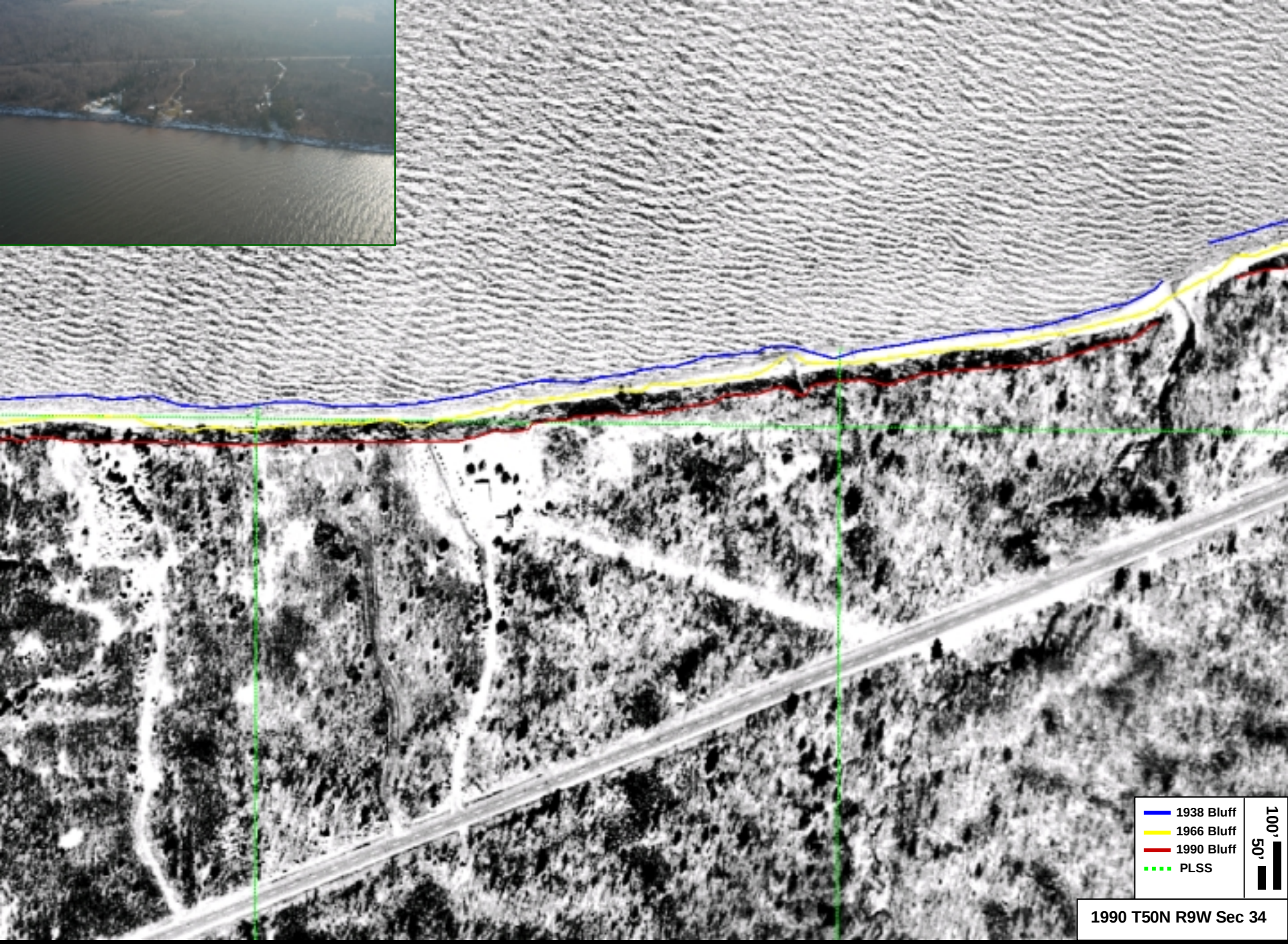

1938 Bluff
1966 Bluff
1990 Bluff
PLSS
100'
50'
1938 T50N R9W Sec 34


1938 Bluff
1966 Bluff
1990 Bluff
PLSS
100'
50'
1966 T50N R9W Sec 34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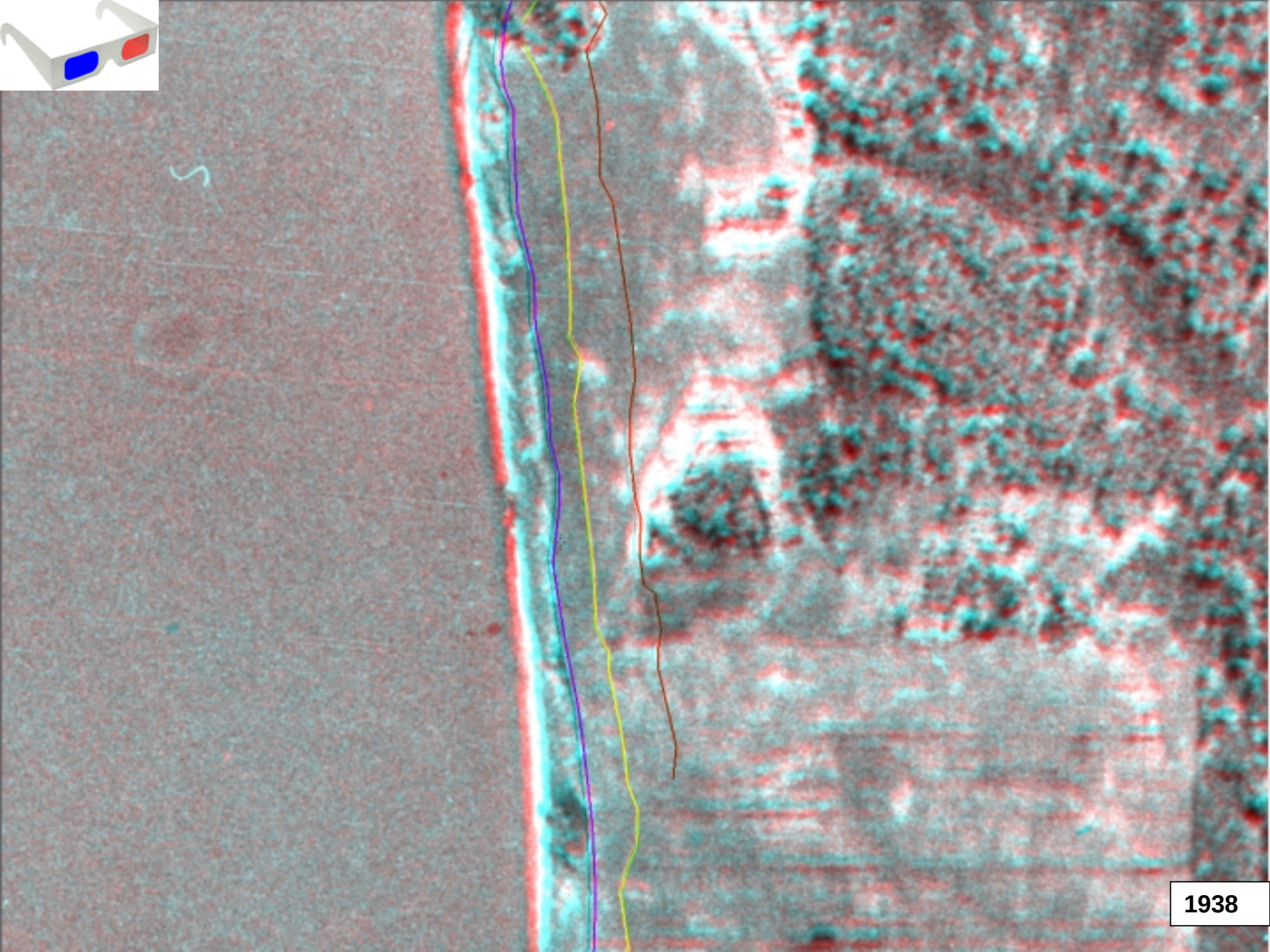
1966 Bluff
1990 Bluff
PLSS
100'
50'
1990 T50N R9W Sec 34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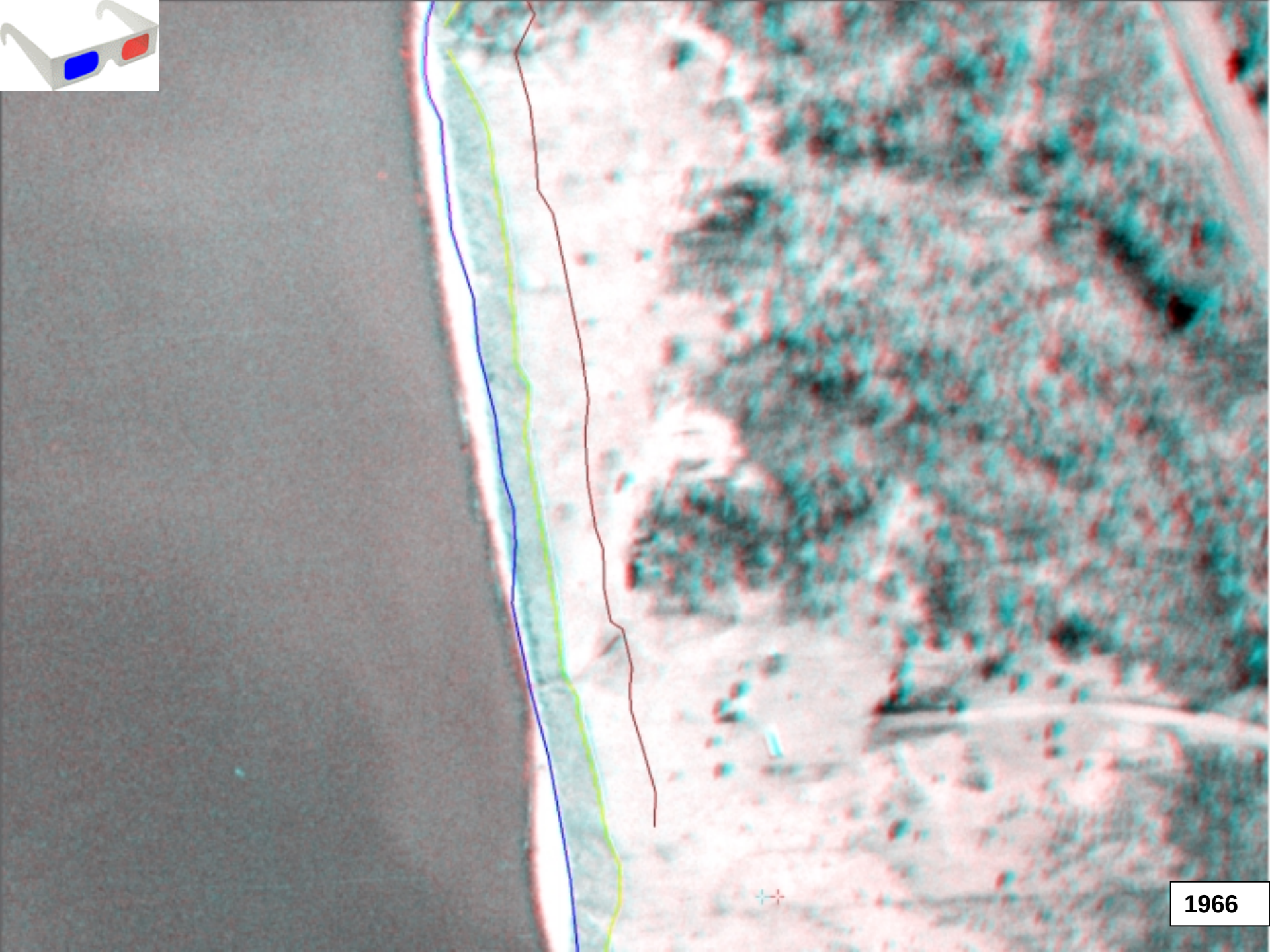
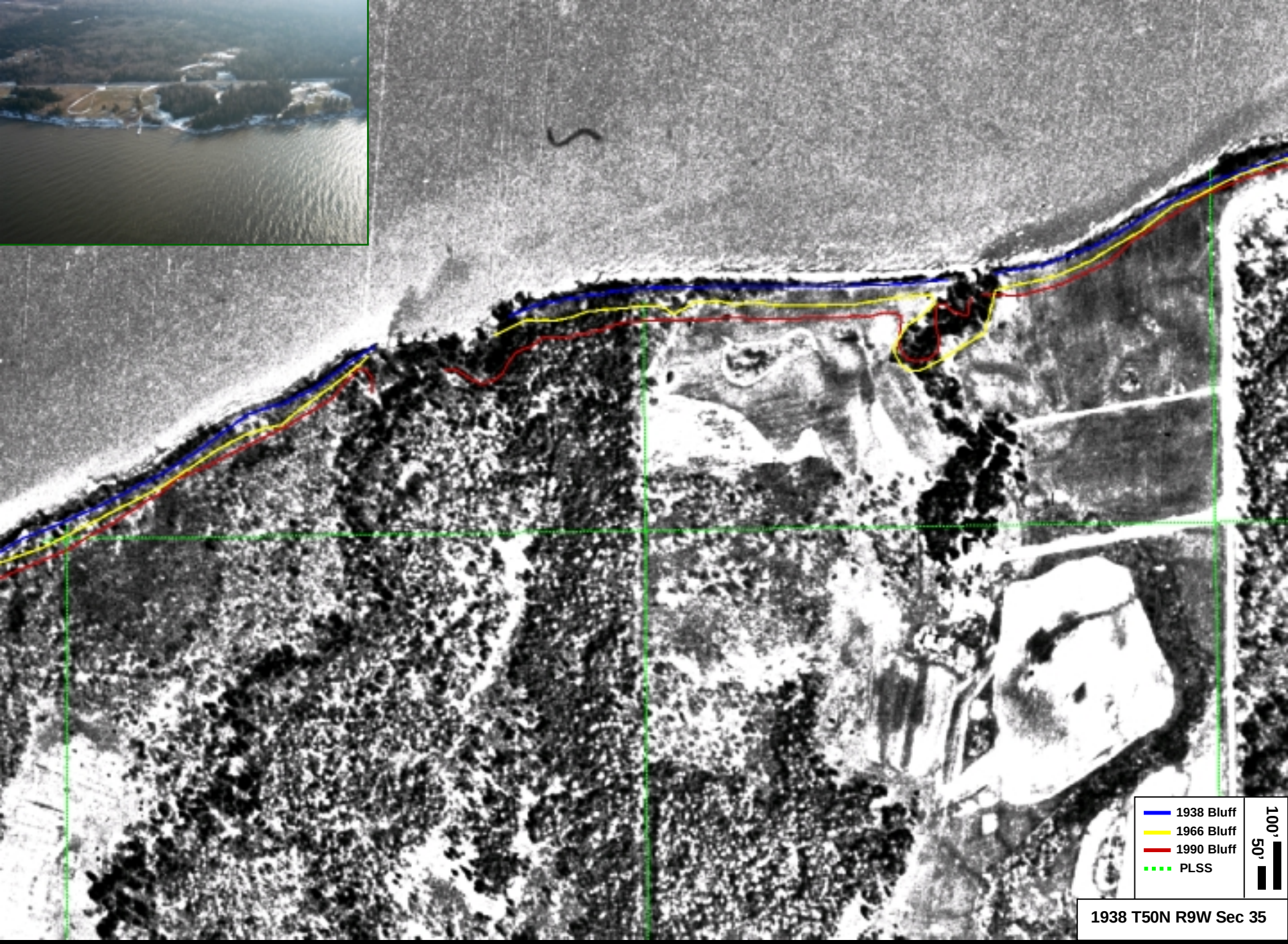
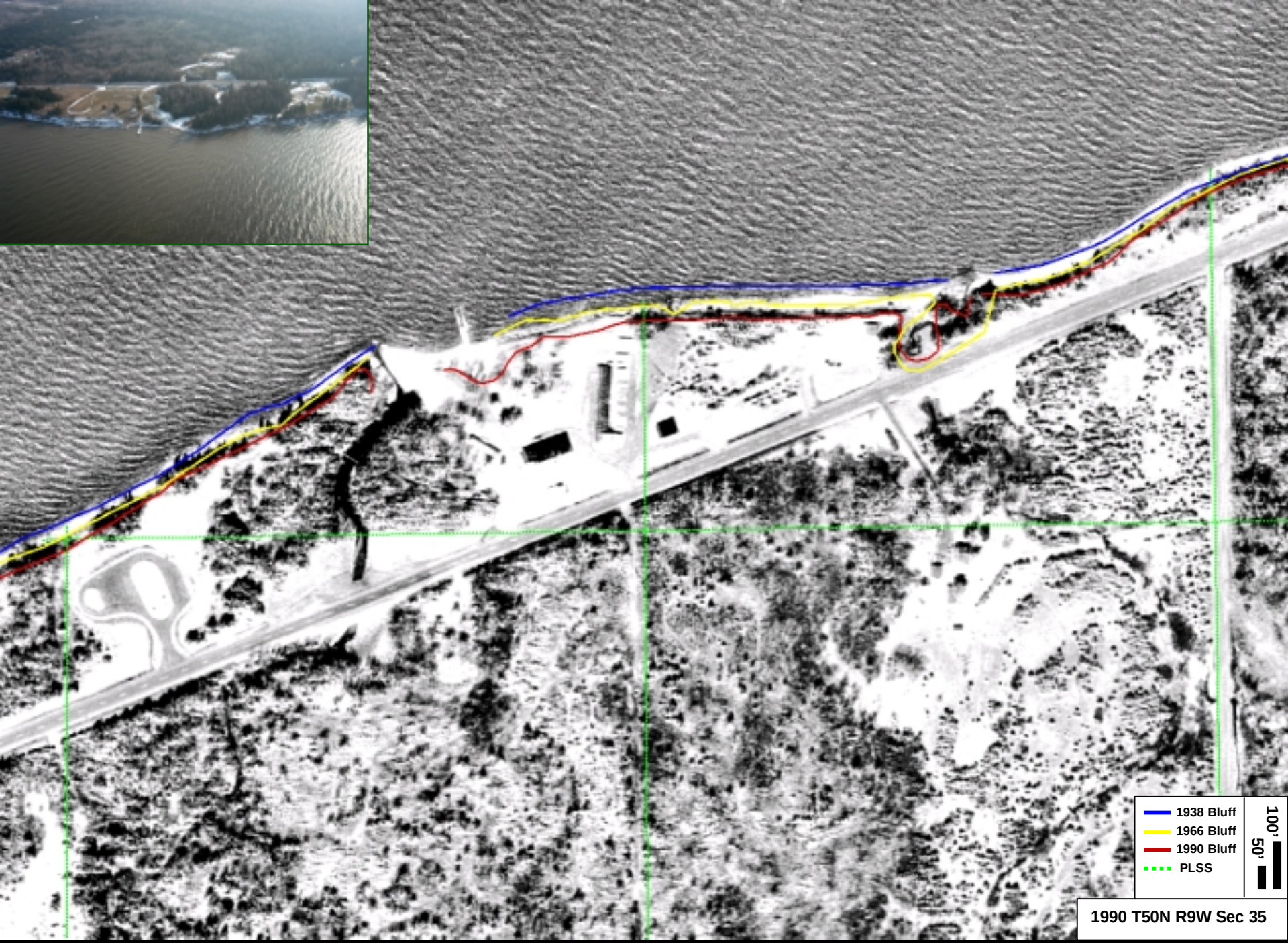

1966


1938 Bluff
1966 Bluff
1990 Bluff
PLSS
100'
50'
1938 T50N R9W Sec 35

1938 Bluff
1966 Bluff
1990 Bluff
PLSS

100'
50'

1966 T50N R9W Sec 35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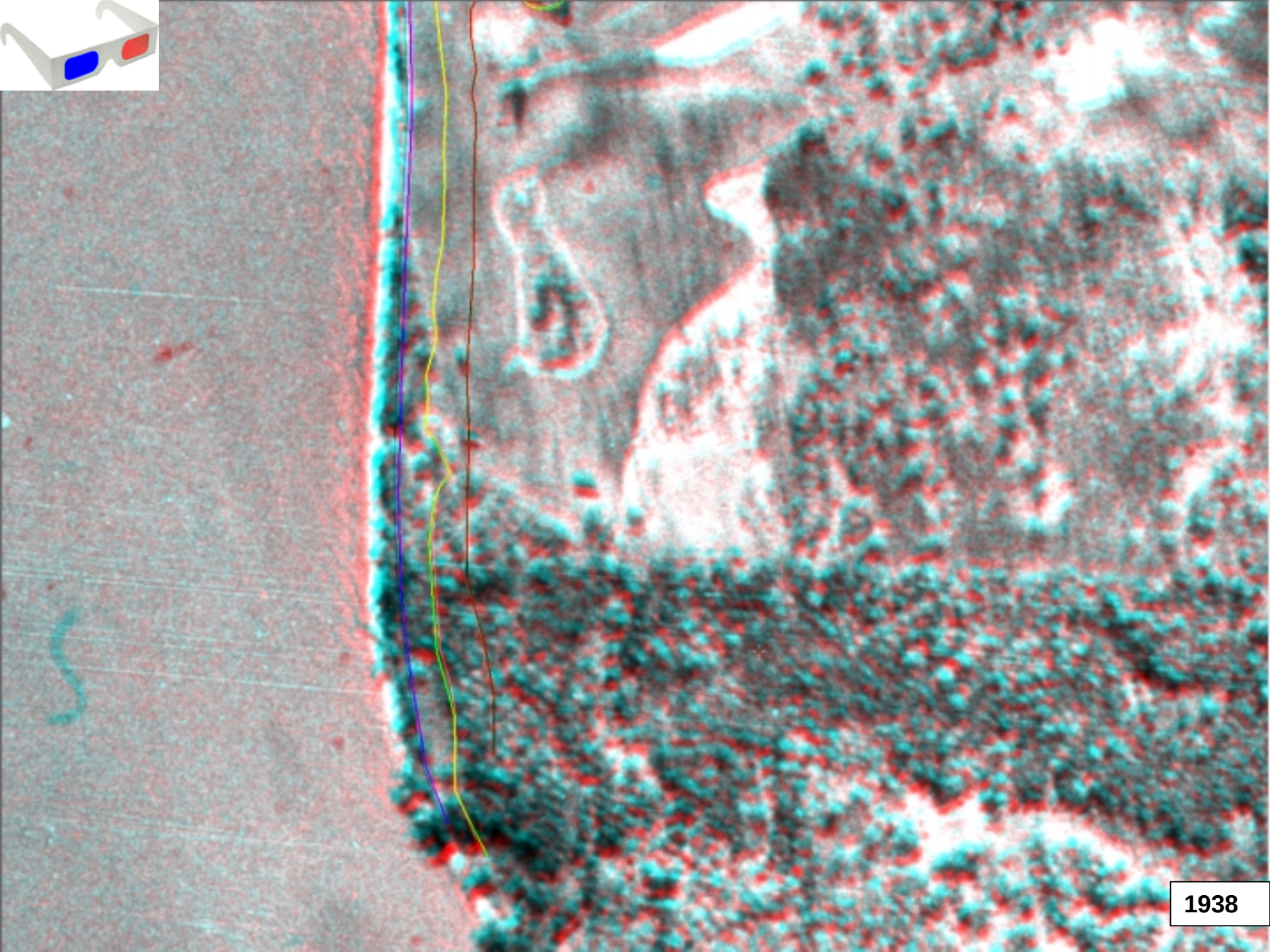
1990 Bluff
PLSS
100'
50'
1990 T50N R9W Sec 35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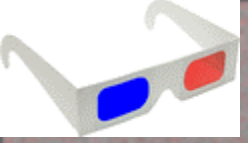
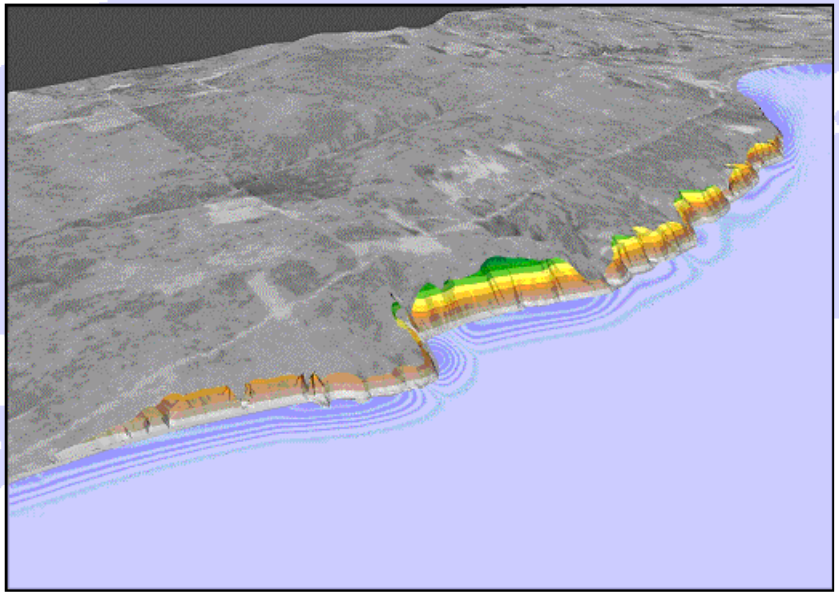


1966

Project Results

- Low cost softcopy photogrammetric workstation can provide reasonably accurate data, especially for non-engineering applications



Oblique Shoreline Imagery

Objectives

- Create a set of photographs providing a baseline for observing changes over time.

- To provide objective scientific information to the local community.

- Create archive to provide a ready source of imagery that can useful for land use planning efforts, public meetings, educational displays, etc.

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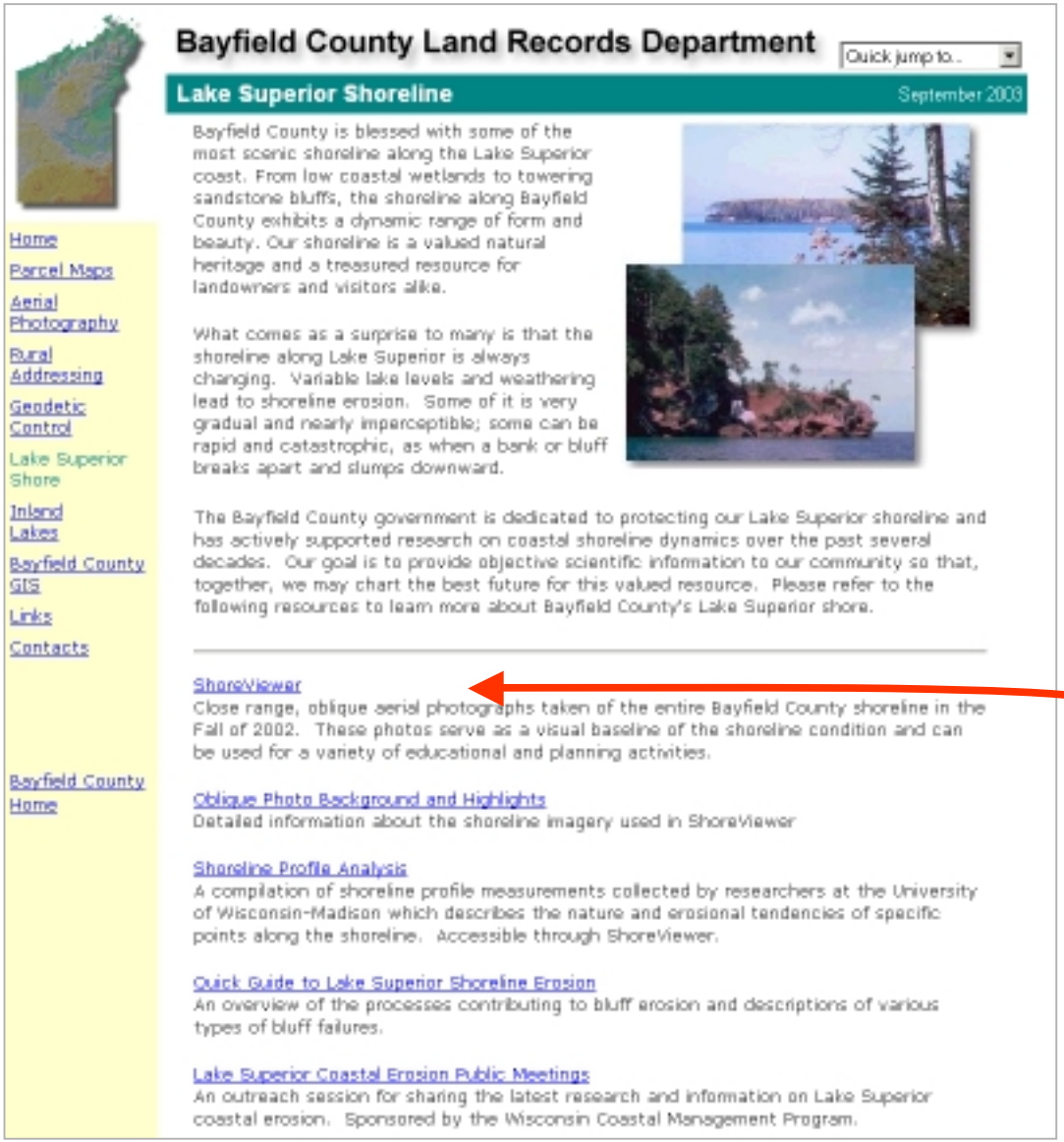
Project Accomplishments

- 513 photos (Fish Creek to Brule River), November 2002
- High Resolution images - 2240 x 1488
- GPS used to record camera position
- Employed the expertise of Bad River Natural Resources personnel
- Created "ShoreViewer" on Land Records website:
  http://www.bayfieldcounty.org/LandRecords/ shoreviewer_start.htm
- Created "Lake Superior Shore Profile Analysis" on Land Records website:
  http://www.bayfieldcounty.org/LandRecords/ shore_2002/info_uwprofiles.htm

Land Records Home Page

ShoreViewer

ShoreViewer



Click to view ShoreViewer Maps & Photos

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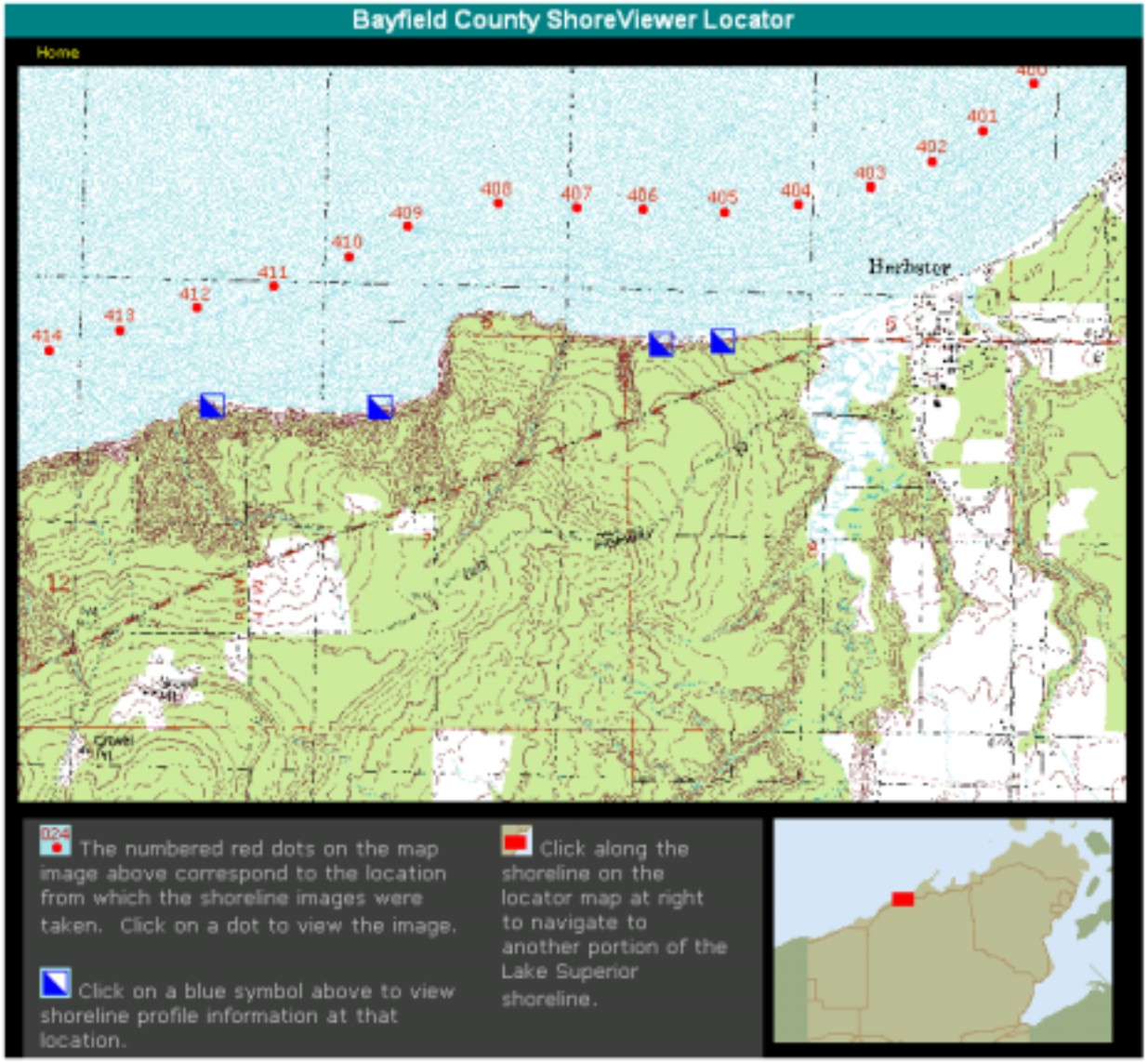
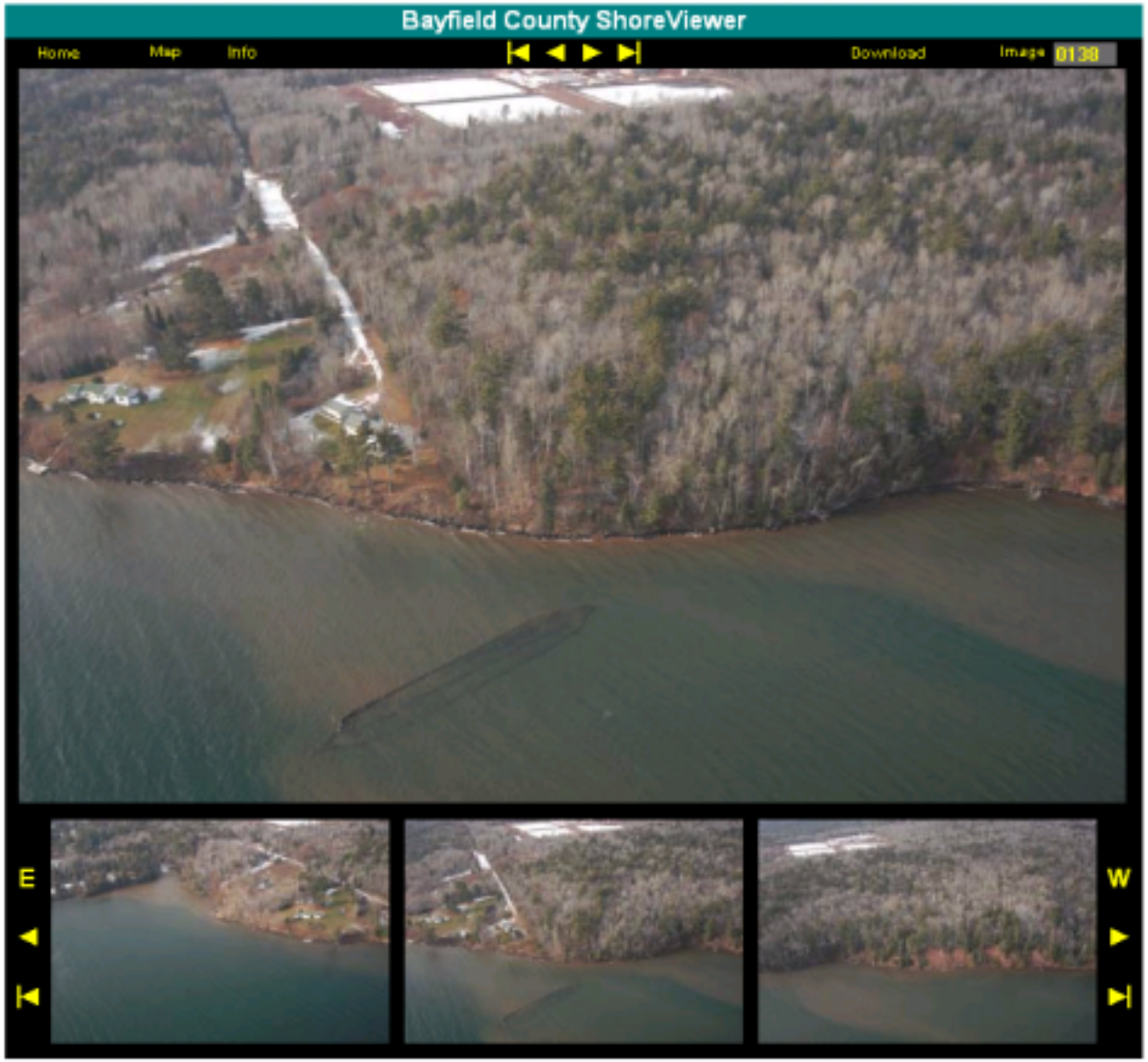
ShoreViewer Locator Map



Example Oblique Photograph



Example Profile

Bayfield County ShoreViewer Profile Detail

Home Info

Profile	BA T48N 4W Sec 19/24 P3
Year Measured	2001
Latitude	46 37 00
Longitude	-90 55 55
Bluff Height (ft)	15
Nearshore Material	fine to med sand
Beach Material	sand, boulders
Seep Present?	no
Seep Location	
Bluff Material	Hanson
Vegetation Amount (%)	5
Vegetation Type	weeds, grasses